

Predator-prey interactions:

*Prey consumption by key
predators in Lake Huron*

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Overview

- Balancing predator forage demand with prey availability
- Stocking
 - Widespread since the mid-1960's
 - Major component of predator populations
 - Potential for predators to exceed forage capacity



Overview

- Review methods
- Consumption in the main basin
- Compare to primary prey abundance
- Consumption in Georgian Bay and the North Channel
- Projected consumption





Key predators in the open waters

Burbot
(*Lota lota*)



Chinook Salmon
(*Oncorhynchus tshawytscha*)



Lake Trout
(*Salvelinus namaycush*)



Walleye
(*Stizostedion vitreum*)



Main constituents in the diet of the key predators

Alewife

(Alosa pseudoharengus)



Rainbow Smelt

(Osmerus mordax)



Others:

Bloater

Sculpin

Stickleback

Invertebrates



Estimating consumption in the main basin

$$\text{Consumption} = \text{Production} / \text{GCE}$$

- Production-conversion efficiency method
- Year- and age-specific consumption
- Data from stock assessment & bioenergetics models



Estimating consumption

$$\text{Consumption} = \text{Production} / \text{GCE}$$

Gross production is estimated from

- Stock assessment model
 - age-specific population abundance
 - mortality rates
- Weight-at-age

Accounts for consumption by fish that die during the model time step



Estimating consumption

$$\text{Consumption} = \text{Production} / \text{GCE}$$

Gross conversion efficiency (GCE)

- Estimated from bioenergetics models
 - Wisconsin Model (version 3.0b)
 - Lake Huron specific values
 - Predicts prey consumption from observed growth

$$\text{GCE} = \frac{\text{predator weight gain}}{\text{prey consumed}}$$



Chinook salmon and burbot model area





Lake trout areas modeled



Walleye areas modeled





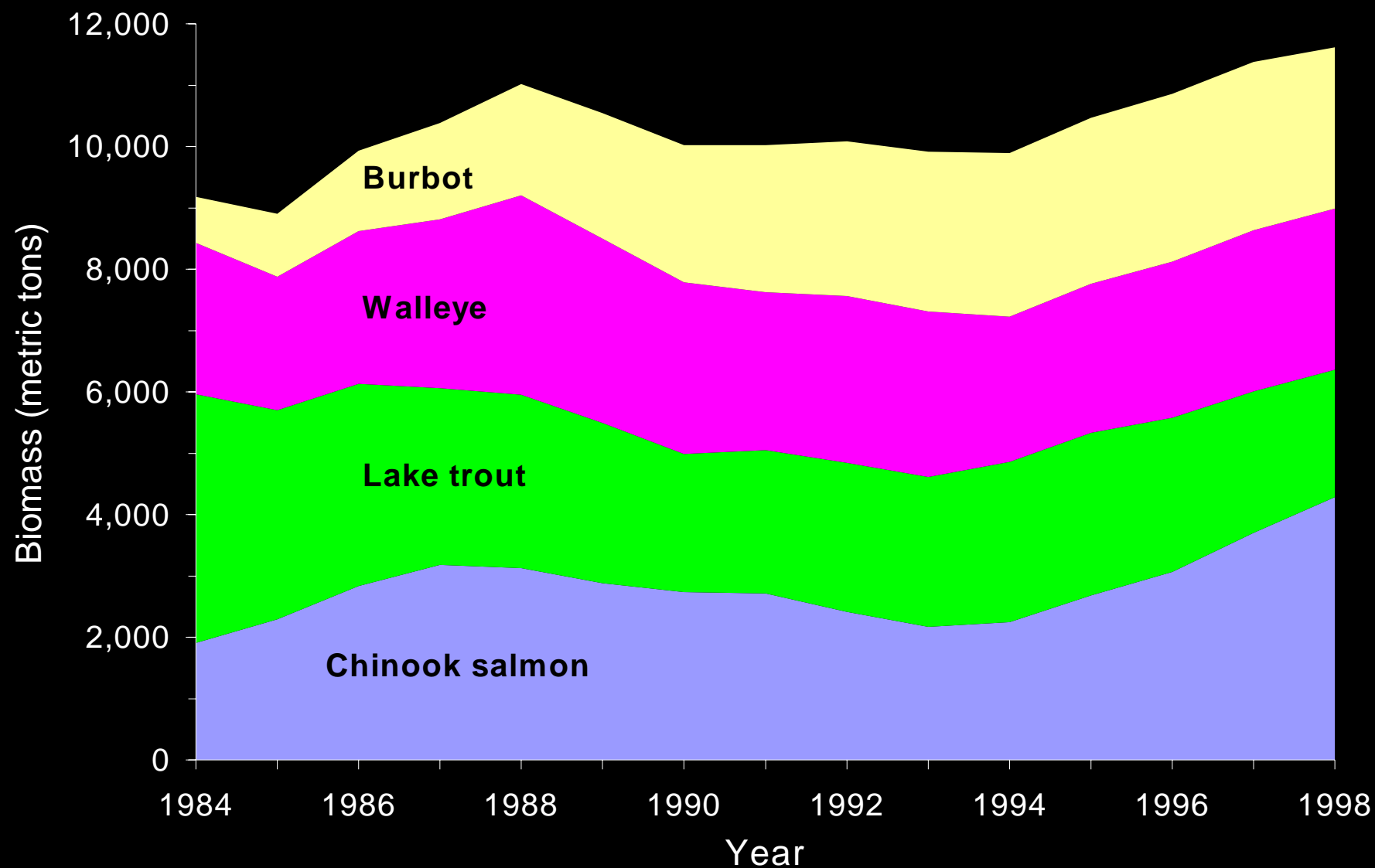
Summary of age-structured stock assessment models

Predator	Areas	Recruitment		Mortality			
		Stocking	Natural	M	SL	F	MAT
Lake trout	3	X	---	X	X	X	---
Chinook salmon	1	X	X	X	---	X	X
Walleye	2	X	X	X	---	X	---
Burbot	1	---	X	X	X	X	---

Models operate on an annual basis

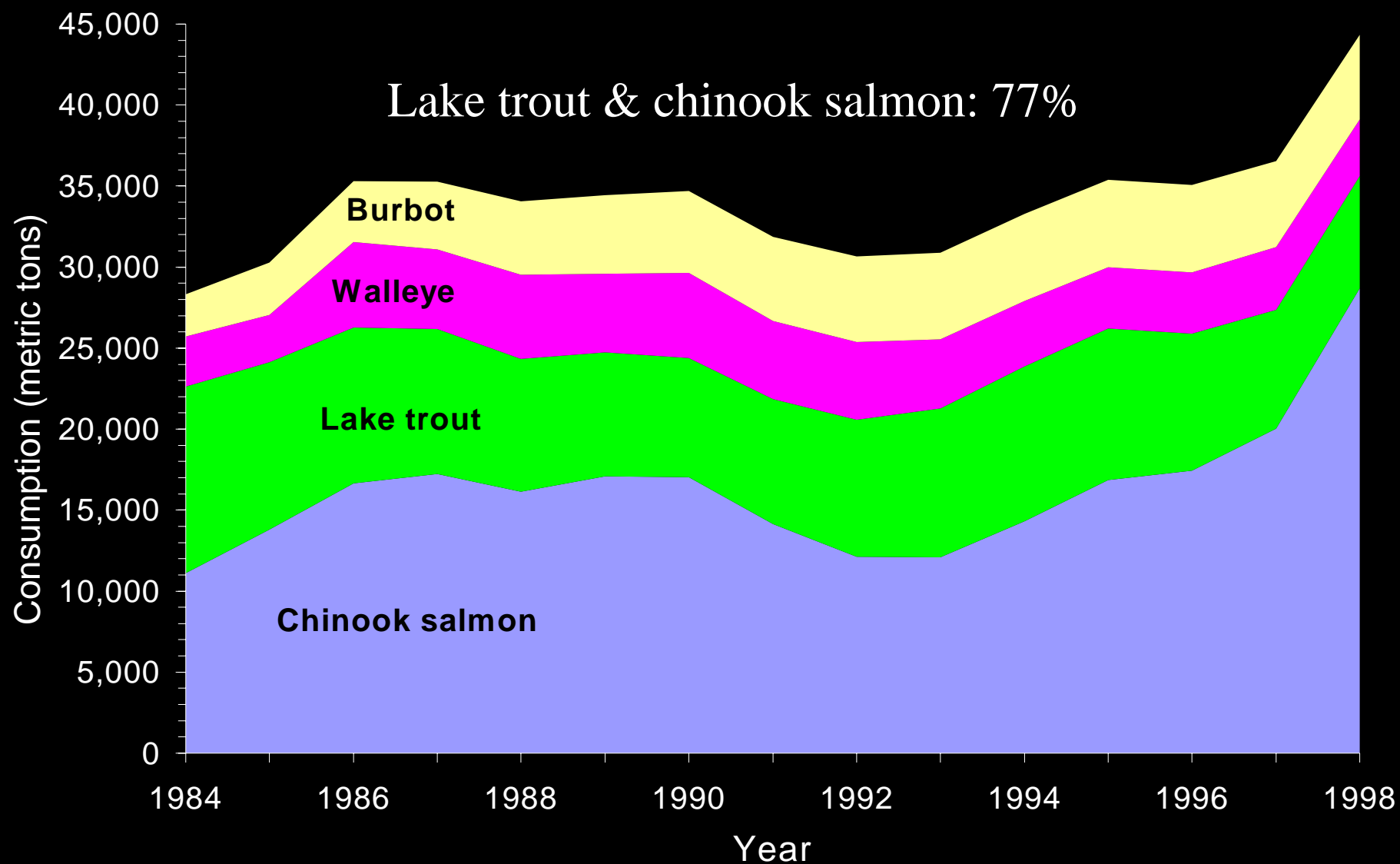


Estimated predator biomass for main basin, 1984-1998



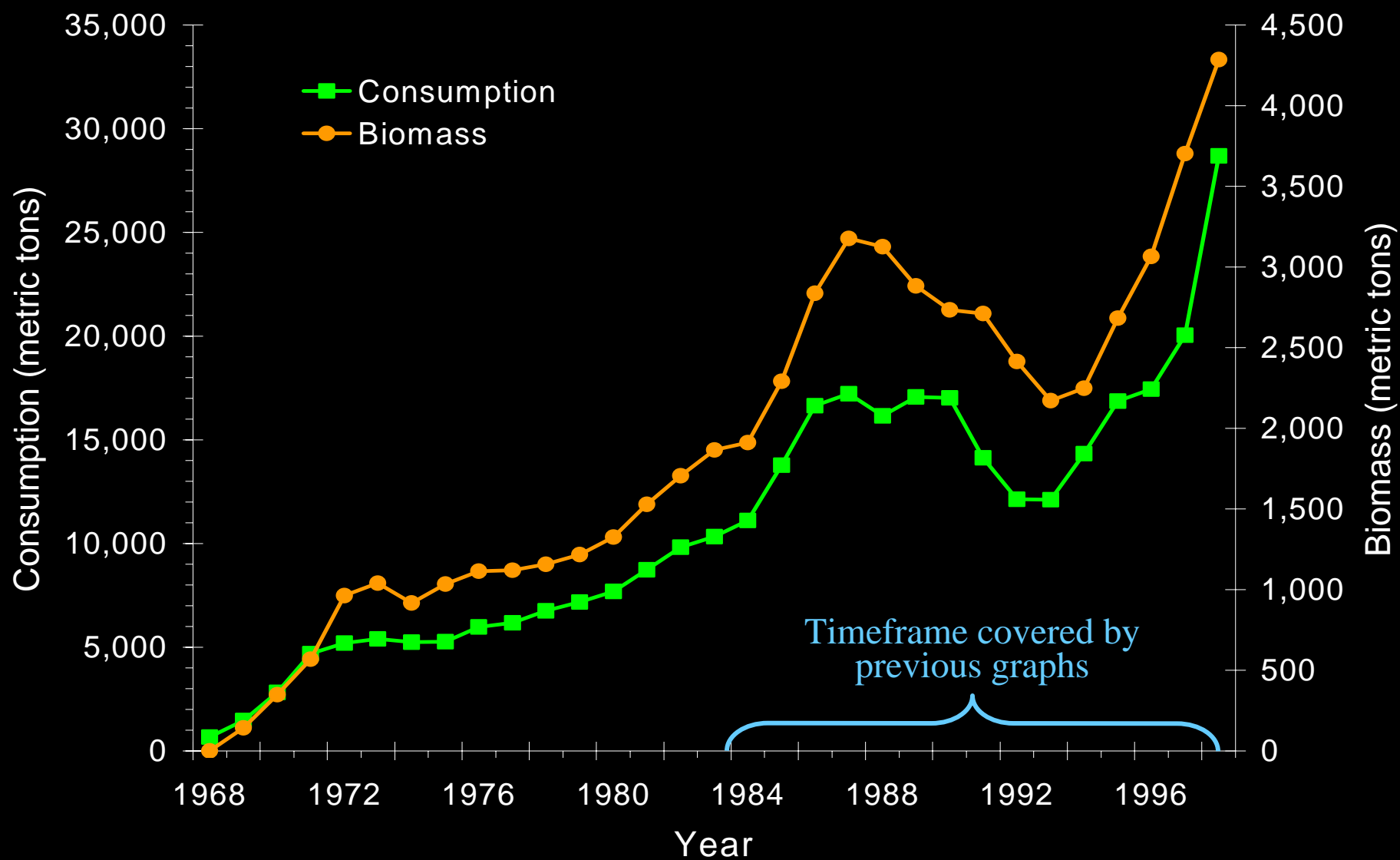


Estimated consumption by key predators in the main basin, 1984-1998



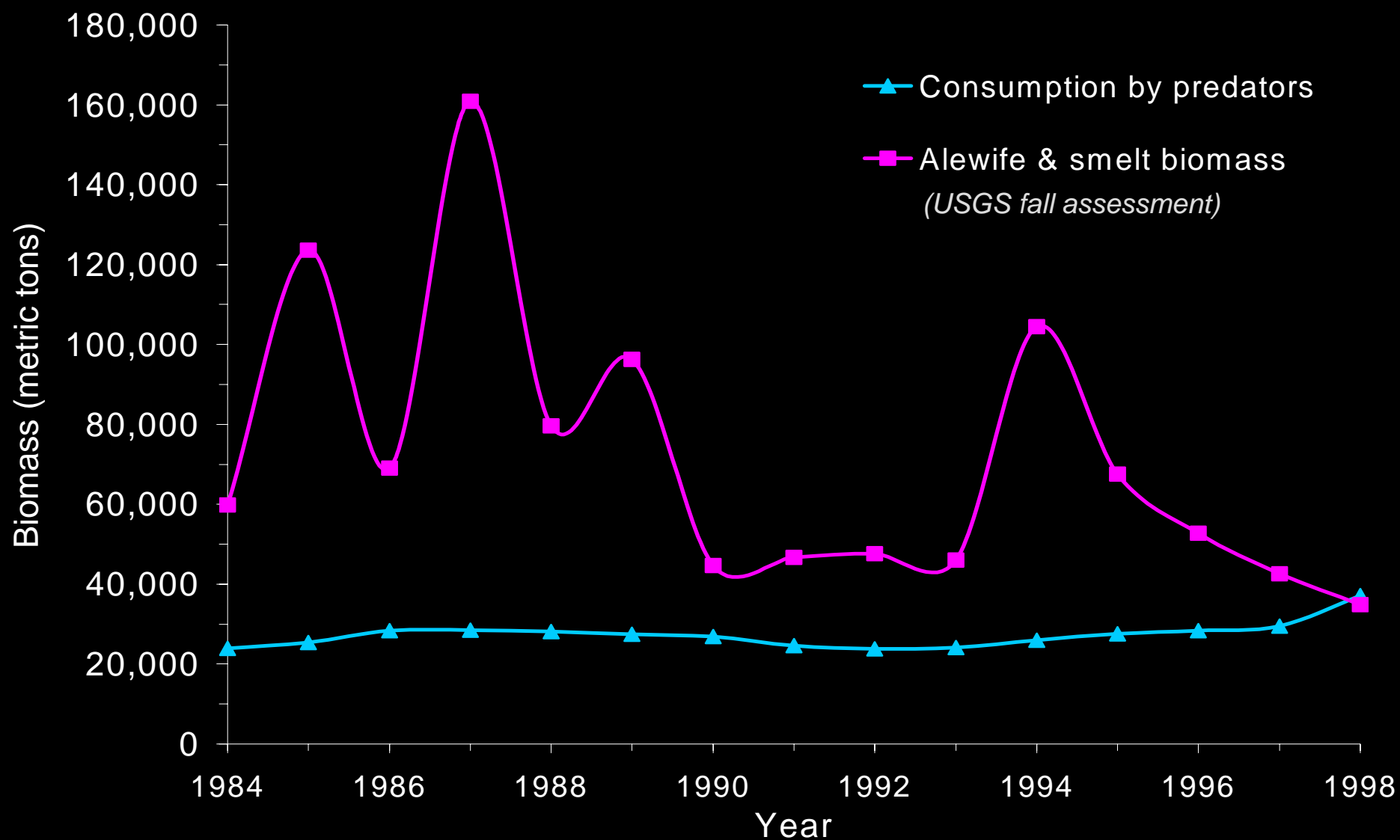


Estimated chinook salmon consumption and biomass in the main basin





Comparison to combined alewife and smelt biomass in the main basin, 1984-1998





Mean consumption in the main basin, 1996-1998 (metric tons x 1000)

Mean consumption: 38.5

	Burbot	Chinook salmon	Lake trout	Walleye
Alewife	1.5	13.6	3.9	1.6
Rainbow smelt	1.1	5.7	3.4	0.5
Other	2.7	2.8	0.3	1.4
Alewife+smelt	2.6	19.3	7.3	2.1

Total alewife+smelt: 31.3



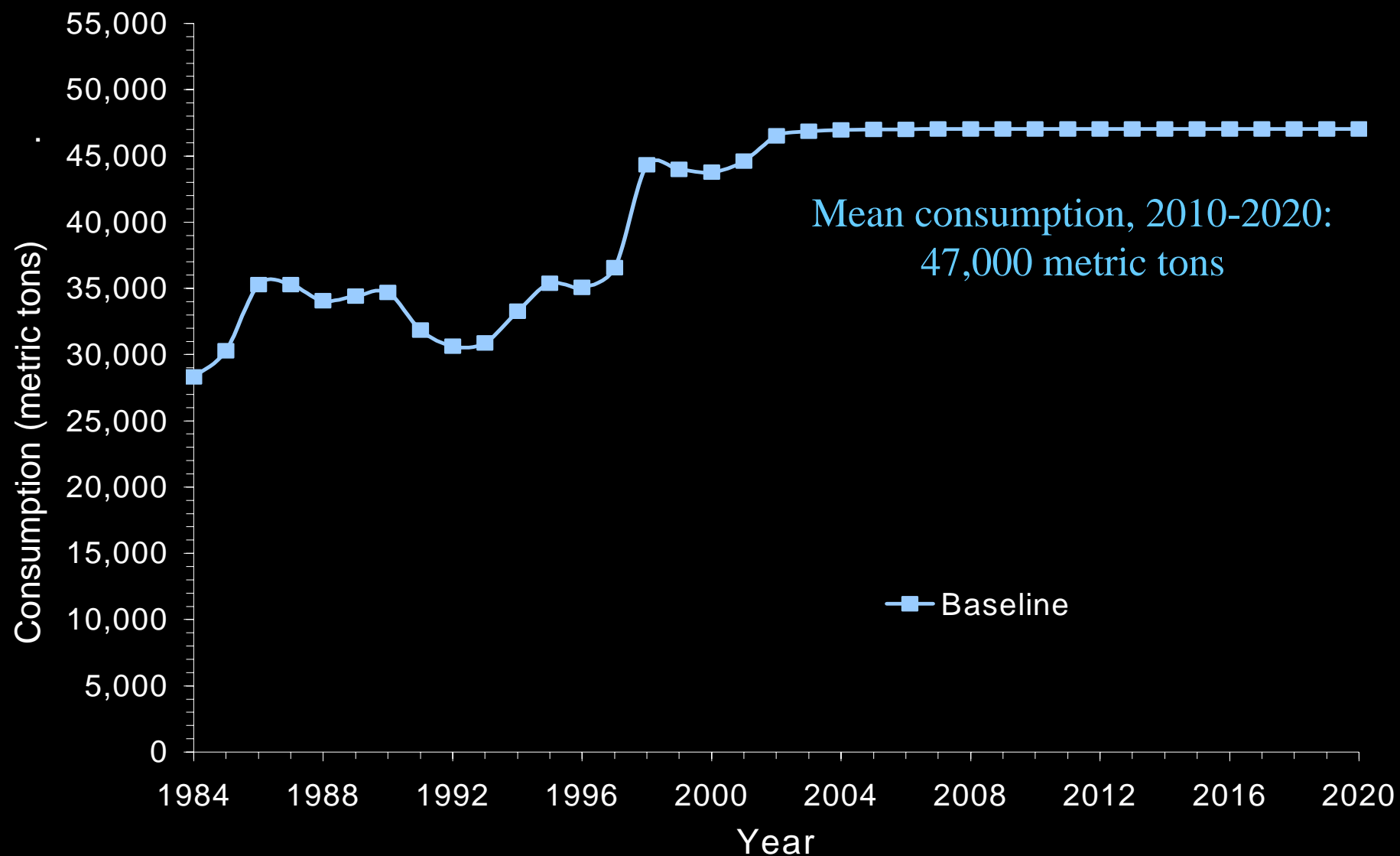
“Back of envelope” consumption
in Georgian Bay (GB) and
North Channel (NC) vs. main basin (MB)

Predator	Consumption (metric tons x 1000)		
	GB	NC	MB (1996-1998)
Chinook salmon	1.8	3.9	22.1
Lake trout	2.2	5.9	7.6
Double-crested cormorants*	1.4	2.1	0.7

* *McLeish, D.A. 1996*

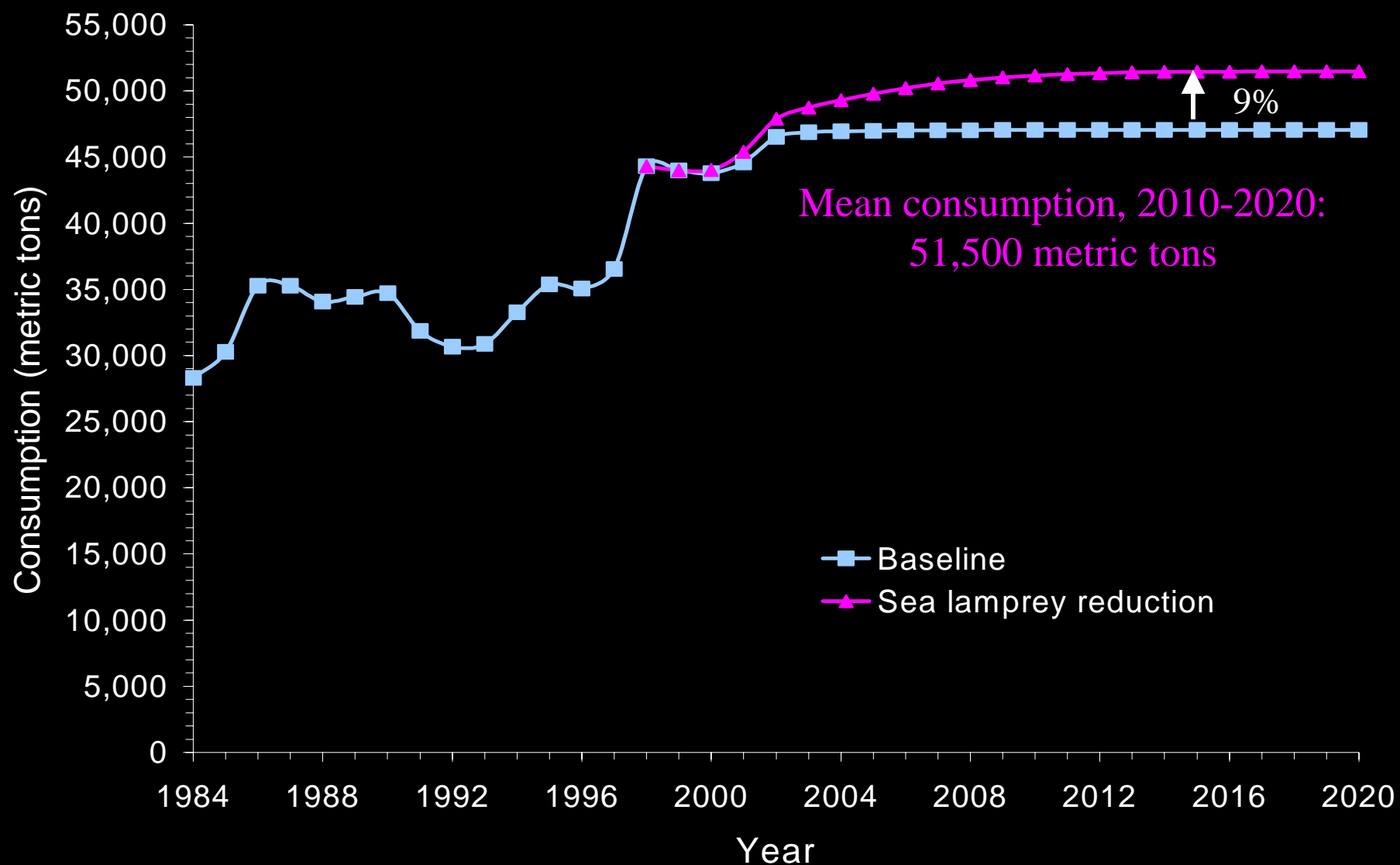


Projected effects of current stocking practices on consumption in the main basin



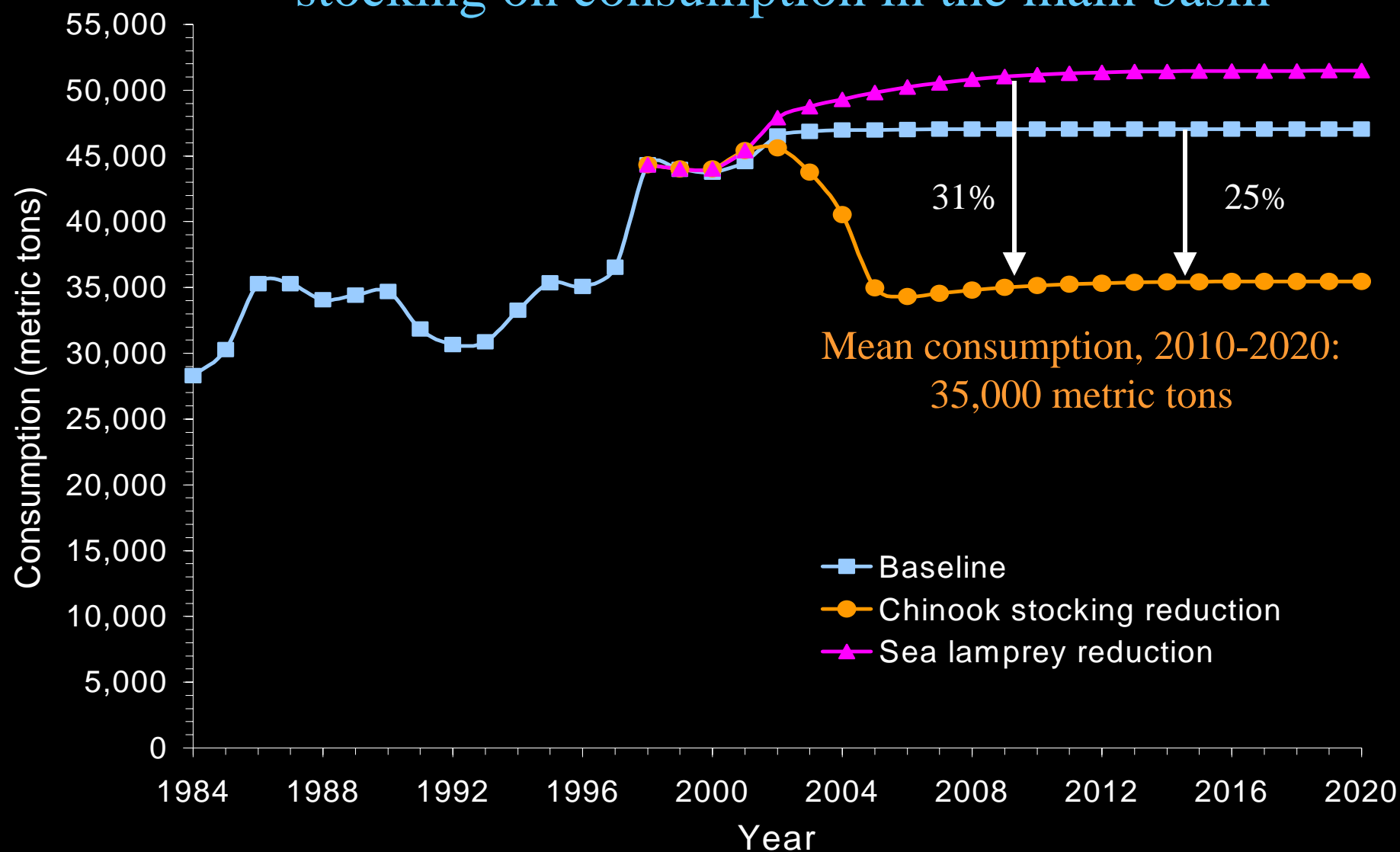


Effects of projected reduction in sea lamprey abundance on consumption in the main basin





Effects of projected reduction in sea lamprey abundance and 50% reduction in chinook salmon stocking on consumption in the main basin





Summary

- Major consumers: lake trout & chinook salmon
- Consumption by key predators may be approaching prey capacity
- Changes in stocking and sea lamprey abundance effect consumption
- Importance of continued monitoring of predators and prey